

# Effect of Modified Tuning Chamber of Reactive Silencer on Noise, Backpressure and Fuel Consumption

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**Abstract** - With the increase in population day by day the number of vehicles also increases which have more contribution towards the increase in noise and more fuel consumption. To reduce the same or to maintain it within the limit the researchers are taking efforts for finding some solution or alternate method, which leads to the development of new things or some modifications in the existing thing. As the major source of pollution are the vehicles, therefore by limiting the scope of pollution to the vehicles only the three different configuration of reactive silencer is designed by modifying the tuning chamber which is the main cause of attenuation and the result recorded for noise level production, back pressure and fuel consumption and by compared with the standard silencer provided by the manufacturer and the optimum design of reactive silencer is proposed which has comparatively less noise at low back pressure with low fuel consumption.

**Key Words:** Backpressure, Reactive Silencer, Tuning Chamber, Configurations, Fuel Consumption, Noise Level.

## 1. INTRODUCTION

The need for analysis of the dynamic behavior of exhaust systems in the automotive industry has increased primarily due to increased fuel consumption because of backpressure in silencer. Also, the increasing vehicles contributing to the increase in sound pollution which is the most critical problem world facing today. The researchers are continuously finding the solutions to limit these two parameters or to maintain it within the limits. For maintaining this sound pollution level within the limits there is continuous development of new thing or modification are carried in existing things so as to give a satisfactory result. Therefore, in this work the modification of bike reactive silencer is made by modifying the tuning chamber and the results are measured and recorded so as to satisfy the requirements also considering increased demands on comfort, it is easily realized that designing exhaust systems has become much more difficult.

## 1.1 Backpressure

Back pressure refers to pressure opposed to the desired flow of a fluid in a confined place. It is often caused by obstructions or tight bends in the confinement along which it is moving. In an automotive muffler, backpressure is caused by the reflection of exhaust through baffle or tight turns. The word back may suggest a pressure that is exerted on a fluid against its direction of flow indeed, but there are two reasons to object. First, pressure is a scalar quantity, not a vector quantity, and has no direction. Second, the flow of gas is driven by pressure gradient with the only possible direction of flow being that from a higher to a lower pressure. Gas cannot flow against increasing pressure. It is the engine that pumps the gas by compressing it to a sufficiently high pressure to overcome the flow obstructions in the exhaust system.

## 2. DEVELOPMENT OF CONFIGURATIONS OF TUNING CHAMBER OF REACTIVE SILENCER

Any reactive silencer has three main parts which are Muffler, Tuning Chamber and End Pipe. All these parts have characteristic function for noise reduction. To reduce the backpressure and noise only tuning chamber is modified with three different configurations with muffler and end pipe kept as same as standard silencer assembly.

### 2.1 Modified Configuration 1

The configuration one of tuning chamber is made by providing extra holes on the baffle plates. In standard silencer one hole was present on baffle plate 1 while three holes were present on baffle plate 2. In first configuration, the one hole plate is replaced by two-hole plate and the plate 2 is replaced by five holes plate as shown in Fig.1



Fig-1: Modified Configuration 1

## 2.2 Modified Configuration 2

The configuration two of tuning chamber is made by increasing the distance between two baffle plates. The increase in length causes increase the flow area of the exhaust gases and the more pressure drops takes place between two plates with reaction of gases. The standard distance between the two baffle plate was 90mm and now it is modified by increasing length between two baffle plate by 10mm. Now total length is 110mm. The first baffle plate has one hole and the second baffle plate has three holes as shown in Fig.2



Fig-2: Modified Configuration 2

## 2.3 Modified Configuration 3

The third configuration of tuning chamber is made by forming an extra chamber. The extra chamber is made by inserting an extra baffle plate between the two plates at a center distance from two. In this third configuration, the end baffle plates have the same geometry as first configuration the difference is extra chamber. The plate 1 has two holes and the plate 2 has five holes same as configuration one while the center plate 3 inserted has four hole as shown in

Fig.3. The purpose of increase in chamber is to increase the reaction of exhaust gases in a compact space.



Fig-3: Modified Configuration 3

## 3. MEASUREMENT OF FUEL CONSUMPTION, NOISE AND BACKPRESSURE

### 3.1 Measurement of Noise Level

Noise is measured by the digital dB meter. All the three configurations are kept inside tuning chamber of reactive silencer as turn by turn. Engine runs on idle condition on 1000, 3000, 5000 rpm respectively and thus noise level is measured by digital dB meter.

### 3.2 Measurement of Backpressure

Backpressure in silencer is measured by means of the vertical U-tube manometer. This U-tube manometer is connected just before the tuning chamber and engine runs at idle condition at 1000, 3000, 5000 rpm respectively and backpressure is measured by the pressure difference in U-tube manometer.

### 3.3 Measurement of Fuel Consumption

Fuel consumption is measured by the fuel measuring instrument. Fuel consumption is measured for limited period of time i.e; for 1min at 1000, 3000, 5000 rpm.

## 4. RESULTS

The noise level reading measured at different RPM is tabulated in Table-1.

**Table-1:** Noise level readings at different RPM

Engine RPM	1000	3000	5000
Standard Configuration(dB)	79	84	89
Configuration 1 (dB)	76	83	89
Configuration 2 (dB)	75	83	88
Configuration 3 (dB)	73	81	85

The backpressure reading measured at different RPM is tabulated in Table-2.

**Table-2:** Backpressure readings at different RPM

Engine RPM	1000	3000	5000
Standard Configuration (Pa)	245.25	735.75	1128.15
Configuration 1 (Pa)	29.43	353.16	686.7
Configuration 2 (Pa)	29.43	294.3	559.17
Configuration 3 (Pa)	58.86	294.3	627.84

Fuel consumption readings for 1 min at different RPM is tabulated in Table-3.

**Table-3:** Fuel consumption readings for 1min. at different RPM

Engine RPM	1000	3000	5000
Standard Configuration (ml)	7	12	28
Configuration 1 (ml)	7	12	26
Configuration 2 (ml)	6	10	23
Configuration 3 (ml)	7	10	27

## 5. CONCLUSION

With the data recorded and measured for noise level, back pressure and fuel consumption for different configuration of tuning chamber it is observed that these three modified configurations of tuning chamber have different reading for the back pressure, noise level and fuel consumption. It means that by designing the silencer with different configuration the said parameters can be increased or decreased. Also, the measured value when compared with the value measured for standard silencer the optimum design of silencer can be proposed.

With the data recorded, it is observed that with changing configuration the sound level is decreased from standard configuration to second configuration at the same time the backpressure value and the fuel consumption is also reduced. With further reducing the sound level it is observed that there is rise in back pressure value and which causes more HC to release.

Therefore, by observing all the three tables it is concluded that the sound level of silencer can be reduced to some level only, with further reducing the sound level the back pressure increases which further increases the ppm of HC because of increased back pressure. Therefore, the silencer configuration second is the optimum designed silencer as it has low noise level at reduced back pressure and the low fuel consumption because of more passage for the flow of exhaust gases.

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